Feature Section

Modern Industries Depend on Electroprocesses

*Charles L. Faust**

Magnitude of the Electroprocess Industry

Electrochemistry and electrometallurgy have made possible a great development of natural resources. The electroprocess industries are the only practical source for commercial quantities of many materials (shown in Table I) now absolutely essential to over-all modern industry. The quantitative data in Tables II and III do not account for all the electroprocess products, but they show that the industry is large.

Approximately 85 to 90 per cent of the chlorine is produced concurrently with caustic soda, the balance with sodium metal, caustic potash, soda ash, and sodium nitrate. The two electrochemical products, caustic soda and chlorine, account for about 20 per cent of the big-tonnage chemicals, which are those exceeding one-half million tons annually and sold in bulk. Chlorine is required in the production of the other products shown in Table V, and 75 to 80 per cent is used in the manufacture of organic chemicals[1].

Since 1945, caustic soda production by the lime-soda process increased by only about 5 per cent, while electrolytic production inc eased by about 55 per cent. Even so, only chlorine of the products from brine or fused-salt electrolysis has been continuously short. Chlorine is used on the spot or is liquefied and shipped in cylinders and in tank cars, and is transported by pipeline. Hydrogen is generally used on the spot, but much goes to waste. On the spot uses include: manufacture of HCl and 33 per cent hydrochloric acid by burning electrolytic hydrogen and chlorine; ammonia synthesis; and hydrogenation of vegetable oils, etc.

Table IV shows some relative figures on employees, products, and dollar volume. Again, all electroprocess industries cannot be included, but the data show clearly that there is a large potential for employment of technical personnel with electrochemical and electrochemical engineering know-how. The electroprocess products are the essential raw materials for the multimillion dollar production of other products and processes. Many large-scale applications are shown in Table V.

The electroprocess industries are large consumers of products of other industries. Many thousands of tons of carbon electrodes are consumed in electrowinning aluminum, magnesium, and sodium, and in making calcium carbide. A very sizeable tonnage of graphite electrodes is consumed in chlorine cells. Millions of tons of salt, of various ores, and of water must be supplied to the electroprocess industries.

TABLE I. *Only the electroprocess industries are the commercial source of many essential materials today*

Sole commercial source for	Best commercial source for
Aluminum	Alkalies
Magnesium	Hypochlorites
Sodium	Chlorates
Calcium	Perchlorates
Calcium carbide	Carbon disulfide
Manganese	Chlorine
Chromium	Fluorine
High-grade-chromium alloys	Pure copper
Silicon	Pure silver
Cyanamide	Pure tin
Carborundum	Pure nickel
Phosphorous	Pure lead
Lithium	Special metals
Fluorocarbons	Abrasives
	Special ferro- and silicon-alloys
	Graphite
	Special steels
	Hydrogen peroxide
	Manganese metal

TABLE II. *The big four of the big-tonnage chemicals (1950)**

Chemical	Annual production (short tons)
Sulfuric acid	12,000,000
Soda ash	5,000,000
Caustic soda‡	3,000,000
Chlorine	2,200,000

* *Modern Industry*, p. 50 (Jan. 1951).

‡ Over 70 per cent is an electrolytic product.

Magnitude of Investment and Size of Plant

The few examples in Table VI show the size of operations and plant investment in the electroprocess industries. They also reveal the need for competent operating personnel trained in electrochemical and electrometallurgical principles and practices.

* Past President, The Electrochemical Society. Much of the information is from the Society's Committee for the Advancement of the Science and Technology of Electrochemistry and Electrometallurgy. The Committee consists of the following Society officers: President R. M. Hunter, Past Presidents A. L. Ferguson and C. L. Faust, and Vice-Presidents J. C. Warner, R. J. McKay, and M. J. Udy.

[1] R. B. MacMullin, *J. Electrochem. Soc.*, **96**, 21*C* (1949).

TABLE III. *Electroprocess products and quantitative data (U.S.A.)*[a]

Product	Quantity data (annual total)		Year
	Tons	Kilowatt-hours consumed (f)	
Chlorine	1,192,000	4,000,000,000	1945
	2,200,000	8,000,000,000	1950
	3,650,000[b]	13,000,000,000	1952
Aluminum	309,000	5,500,000,000	1941
	911,000	16,500,000,000	1943
	603,000	11,000,000,000	1949
	1,276,000[b]	23,000,000,000	1952
Magnesium	183,500	2,900,000,000	1943
	9,000	145,000,000	1948
	125,000[b]	2,000,000,000	1952
Copper refined[c]	1,031,600	2,500,000,000	1949
	1,373,200	3,200,000,000	1950
Zinc (from one refinery)	70,000	230,000,000	1950
Nickel anodes for plating	8,530	20,000,000	1945
	13,810	32,000,000	1949
Zinc for steel protection (hot dip + electro)	370,969	—	1948
	350,880	—	1949
	438,000	—	1950
Zinc in wet batteries	1,368	—	1948
	1,359	—	1949
Cadmium electrocoatings	3,791	11,000,000	1948
	4,012	12,000,000	1948
Lead in storage batteries	405,000	—	1948
	280,000	—	1949
Electric steel	2,871,569	1,700,000,000	1941
	5,540,000	3,200,000,000	1950
Electric stainless steel	400,000	260,000,000	1950
	800,000[b]	520,000,000	1952
Electrotinned steel	2,149,674	—	First 9 months of 1950
Hot-dip-tinned steel	1,438,246	—	
Phosphorous	48,000	270,000,000	1940
	100,000	540,000,000	1945
	150,000	720,000,000	1950
Caustic soda	1,129,000	1,700,000,000[e]	1945
	1,387,000	2,100,000,000	1947
	1,588,000[c]	2,400,000,000	1948
Perchlorates[d]	1,000	3,000,000	Prewar II
	20,000	75,000,000	Postwar II
Chlorates[g]	25,000	75,000,000	1947
Calcium carbide	608,337	2,100,000,000	1947
	682,934	2,300,000,000	1948
	605,356	2,000,000,000	1949
Calcium cyanamide	5,000	16,000,000	1909
	116,000	370,000,000	1949
	235,000	750,000,000	1950

[a] Data from: *Iron Age* (Jan. 4, 1951); *Plating*, 434 (April 1950); *Daily Metal Reporter, Metals*, 20 (Mar. 1951); *Eng. Mining J.*, **152**, 83, 85 (Feb. 1951); *Chem. Eng. News*, **92**, 368 (1951); *Ind. Eng. Chem.*, **40**, 2010 (1948); *Chem. Eng.*, **58**, 115 (1951).

[b] Estimated.

[c] 67½ per cent of total produced. Production reached an annual rate of 1,859,000 tons in December, 1948.

[d] J. C. SCHUMACHER, *Trans. Electrochem. Soc.*, **92**, 45 (1947). C. A. HAMPEL AND P. W. LEPPLA, *Trans. Electrochem. Soc.*, **92**, 55 (1947).

[e] *Eng. Mining J.*, **152**, 80 (Feb. 1951).

[f] According to data in *Chem. Eng.*, **58**, 115 (Mar. 1951).

[g] N. C. WHITE, *Trans. Electrochem. Soc.*, **92**, 15 (1947).

The Electric Power Situation

It is increasingly evident that the electroprocess industries offer the only means for economic production of high-quality materials of controlled specifications. The spectacular growth of such industries is shown by the increased electric power needs shown by Block[2] and by *Power Engineering*[3]. By extrapolating the figures and trends cited in these two references to the year 1953, the growth picture shown in Fig. 1 is obtained.

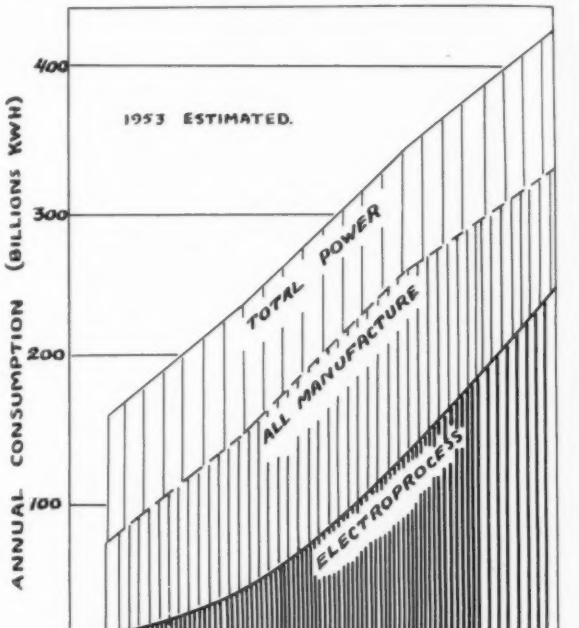


FIG. 1. Electric power consumption by electroprocess and all manufacture relative to total power consumed in U.S.A.

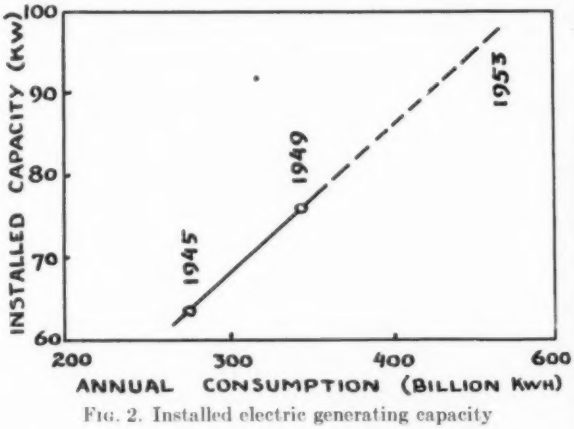


FIG. 2. Installed electric generating capacity

Today we are better prepared for an ample supply of electricity than we were ten years ago. Manpower, not electrical power, appears the more likely bottleneck in an emergency increase in production. If we are faced with an increasing

[2] IVAN BLOCK, *Trans. Electrochem. Soc.*, **91**, 28 (1947).

[3] *Power Engineering*, pp. 54–59 (Jan. 1951).

load, the electric power industry is capable of generating twice as much as was produced during 1941–45, when the total was *one trillion* kwhr in a five-year period under emergency conditions.

Installed capacity is being increased so anticipated needs can be met with a safe margin, unless power-demanding processes for defense would be located where power cannot be made available to them, or unless manufacturing facilities for power supply equipment are diverted to other production, of if materials needed for such power-producing equipment are not diverted to other uses[4]. From the *Power Engineering* article, installed electric generating capacity is estimated as shown in Fig. 2.

Thus, the availability of electrical energy appears assured, but are the technical manpower needs assured for the research, development, and production requirements?

TABLE IV. *Some data on electroprocess industries**

	Employees (Thousands)	Salaries and wages ($Million)	Production workers (Thousands)	Production wages ($Million)	Value added by manufacture ($Million)
Alkalies and chlorides‡	19.9	63.8	15.0	45.5	113.9
Storage batteries	16.6	48.4	13.6	38.3	114.2
Primary batteries	10.2	24.5	9.2	20.7	45.3
Electrometallurgical products	9.6	29.3	8.1	23.4	55.5
Copper	14.6	44.8	13.1	39.0	134.7
Aluminum	8.9	26.4	7.3	20.9	65.3
Nickel					22.5
Electroplating (classified as such)	28.2	76.3	25.6	64.5	125.4
Electroplating (captive departments)§			39.2		192.1
Electrotyping and stereotyping	7.2	31.4	5.6	23.7	47.9
Electronic tubes	27.7	65.4	22.6	46.7	94.0

* Compiled by R. J. McKay, Vice-President, The Electrochemical Society.

‡ In one alkali-chlorine plant (220 tons/day), of 200 employees, 40% are technical and administrative, and 60% are on direct operations.

§ Estimated, and excluding the automobile industry, which [according to *Plating*, 434 (Apr. 1950)] employs 34,000 people to apply the average of 50 square feet of plated surface per automobile. The value of the plating exceeds $300,000,000 annually, and the industry has an investment of $170,000,000 in plating plant, excluding the value of building.

Nonproductive Phases of Electroprocesses

The electroprocesses that do not relate to manufacturing commodities cannot be covered in this short article, but they should be mentioned. Corrosion costs the American people about 6 billion dollars annually. Corrosion itself and the methods of combatting it are substantially electrochemical. Although tremendous strides have been made in the last ten years in preventing corrosion or in minimizing its ravages, there is much to be done in research and in understanding by design and operating personnel for maintenance of equipment and survival of products. In 1948, 367 tons of magnesium were used for cathodic protection. Thousands of tons of zinc, tin, nickel, and copper are used annually to protect millions of tons of steel products.

The methods and tools of electrochemistry are being used extensively in every branch of medicine, and especially in biochemistry, bacteriology, and general physiology. Electrochemistry is finding greater importance every day in zoology, botany, and agriculture. At the University of Michigan, Professor A. L. Ferguson has an elementary course in electrochemistry just for such groups, so they can learn electrochemical principles, techniques, and instrumentation, and can more intelligently read the modern literature of importance to their own fields which are not electrochemical or electroprocess.

The electrochemical aspects of nerve impulses are being

TABLE V. *Products made with, and uses of, materials derived from electroprocess methods*

Uses of electroprocess products in other manufacture	Electroprocess product or process involved
Pulp and paper	Chlorine (600 tons/day), caustic soda
Glycols	Chlorine (over 100 tons/day)
Carbon tetrachloride	Ditto
Trichlorethylene	Ditto
Vinyl chloride	Ditto
Water and sewage treatment	Ditto
Ethylene dichloride	Ditto
Organic and inorganic chlorides	Chlorine (over 20 tons/day)
Butadiene	Ditto
Vinylidine	Ditto
Insecticides, such as *p*-dichlorbenzene, B.H.C., D.D.T.	Chlorine (over 20 tons/day), phosphates, caustic soda
Food processing	Ditto
Textiles (other than rayon)	Chlorine, caustic soda
Rayon and films	Caustic soda
Rubber reclaiming	Ditto
Petroleum refining	Ditto
Food products	Caustic soda, phosphates
Titanium, zirconium	Magnesium
Soap, cleansers, cleaners	Caustic soda, phosphates*
Tetra ethyl lead	Chlorine, sodium
Refrigerants	Chlorine
Glass and ceramics	Caustic soda
Special alloys	Aluminum, magnesium, chromium, manganese
Stainless steels	Chromium, nickel
Corrosion protection and metal decoration	Zinc, cadmium, nickel, chromium, gold, silver, copper, brass plating
Cathode protection	Magnesium, aluminum
Anodes for electroplating	Nickel, copper, zinc
Chromic acid manufacture	Caustic soda
Asphalt preparation	Phosphorous pentoxide
Metal finishing	Phosphoric*, hydrochloric, perchloric acids
Fertilizers	Phosphates*, calcium cyanamide
Acetylene, for organic synthesis and for welding	Calcium carbide
Sulfa drugs, sodium cyanide, organic synthesis	Calcium cyanamide
Batteries	Zinc, lead, magnesium
Matches	Chlorates, phosphorous calcium carbide
Acetylene	Calcium carbide

* Derived from electric furnace phosphorous.

[4] Charles E. Wilson, *Power Engineering, loc. cit.*

studied by Robert Gessel[5], and independently by D. Nachmansohn[6]. The basic mechanisms of the production and the flow of electricity in living nerve cells are under study.

Manpower for Electroprocess Industries

The Electrochemical Society made a brief survey of its academic and industrial members in its various fields of activity. The purpose was to disclose the status of the teaching of subjects to fit graduates of universities for employment in the electroprocess fields and to learn whether industry was receiving an adequate supply of trained men. The response was quite startling in the face of the known industrial and scientific need now, and the greater need anticipated in the future.

The results leave little doubt that there is difficulty in finding men with electrochemical training, unless they have obtained it after leaving college. A large percentage of those employed in electroprocess work had no formal course work designated as electrochemistry, or electrometallurgy, in their university curricula. When there was electrochemical training, in many cases it was part of some other course, usually physical chemistry.

The prevailing and inadequate situation today is that employers seek men who are well trained in physical chemistry and chemical engineering with the hope that they have had some training in electrochemical principles. Then, the employer allows two to three years or more of plant training before a new graduate is considered ready for independent work or responsibility in electrochemical activity. Clearly, there is a need for training that will fit a graduate for a position in the electroprocess field. Of the technical men in electroprocess work covered by the respondents to the questionnaire, only 31 per cent had university courses that were called electrochemistry, and 73 per cent received electrochemical teaching as a part of a course under another title. Of the men in positions of responsibility for electroprocesses, 48 per cent had no formal training of any kind in electrochemistry.

What was found when this manpower-in-electroprocess-technology situation was investigated in the universities? A. L. Ferguson, when he was President of The Electrochemical Society, made a preliminary, but rather extensive study which confirmed the following:

Administrators of academic institutions, heads of chemistry departments, members of chemistry staffs, members of metallurgical and chemical engineering staffs, and students in those fields, are almost totally uninformed on the electroprocess industries and of their magnitude and importance. Personnel men from electroprocess industries have been unaware of electrochemical knowledge and of its value to their company's business.

There is a strong tendency for chemistry (and chemical engineering) departments to omit courses and course work in electrochemistry. The attitude is, for one thing, that the demand has disappeared; for another, it is not possible to find teachers of the subject; and for still another, there are many new fields, such as atomic and nuclear studies, quantum and wave mechanics, and applied mathematics. Something else had to give way for training in these new fields. And, teaching of electrochemistry and "old-fashioned" physical chemistry disappeared.

Some industrial employers have remarked that, for their needs, enough electrochemistry is contained in a good physical chemistry training. This attitude reveals that they are not familiar with the nature of the material now appearing in the textbooks, and particularly, in the teaching phase. Textbooks are swinging to the ultramodern developments along highly theoretical lines. Teachers carry this even farther away from

TABLE VI. *Selected data on size of electroprocess plants and investment*

Plant or product	Capacity of one plant	Electrical power	Cost of plant
Copper refinery	144,000 tons/yr	40,000 amp—65 to 100 v, D.C.	$16,000,000
	36,500 tons/yr	8,750 amp—70 v	2,000,000
Electrotin plate	10,000,000,000 ft²/yr	100,000 amp	
Phosphorous*	10,000 to 12,000 kw/furnace (17,000 tons/yr)	86,000,000 kwhr/yr	9,000,000
Chlorine	220 tons/day	770,000 kwhr/day	15,000,000
	50 tons/day	175,000 kwhr/day	3,940,000
Automobile industry electroplating	6,000,000 cars/year 300,000,000 ft²/yr	36,000,000 kwhr/yr	170,000,000
Aluminum (one plant)	75,000 tons/yr	1,300,000,000,000 kwhr/yr	80,000,000
Calcium carbide (one furnace)	20,000 tons/yr (15,000 kw)	68,000,000 kwhr	1,600,000
Zinc refinery	70,000 tons/yr	250,000,000 kwhr/yr	
Perchlorate	14,400 tons/yr	50,000,000 kwhr/yr	6,000,000
Manganese	4,000,000 lb/yr	21,000,000 kwhr/yr	750,000
Electrotin	680,000 tons/yr Electrotinned steel (7,500,000 lb of tin)	15,000,000 kwhr/yr	

* *Chem. Eng. News*, **29**, 2019 (May 21, 1951).

[5] Head, Department of Physiology, University of Michigan.

[6] Department of Neurology, College of Physicians and Surgeons, Columbia University.

the practical. Physical chemistry has expanded so much that all phases cannot be covered, which results in emphasizing those portions in which teachers are most interested or are most "popular" at the time. The interest in new fields is, of course, necessary for over-all progress, but the backbone must still be a basic curriculum designed to meet the current industrial need.

Fundamental researches in electrochemistry and electroprocessing are becoming less popular for faculty men, because of the newer developments that are more glamorous and newsworthy, and because they are not familiar with the opportunities. The same holds for the younger men who are just charting their education needs. These facts constitute a major challenge to universities and electroprocess industries to get together and work out a realistic understanding of the needs of each other. In the first part of this article, "size-figures" are cited to illustrate the industrial reasons for electrochemical training for production.

In the "classical" sense, the aqueous electrolysis processes are the most likely to be considered electrochemical. But, electric smelting requires electrochemical engineering training just as much. An electrical engineer will not have the "chemical" background for design, building, or operations; neither will the usual type of chemical engineer, who is not trained in the electrical and materials phases. Only the man with physical chemical, chemical engineering, metallurgical, and electrical engineering training, in other words an electrochemical engineer, will have the best background. The same is true for batteries (one dry cell manufacturer will produce one million per day, and there are several different manufacturing companies), for electronics in many of its phases, and so on.

Electrochemical Society Fills A Need

Many more facts on the size of electroprocess industry and on the growing significance of electrochemical research could be added in a longer discussion. The clear needs for the educational situation would be emphasized even more. Progressive men and women in engineering, scientific, commercial, and all chemical and metallurgical fields, must, of necessity, be in touch with electrochemical development and progress. The Electrochemical Society aids in filling that need after graduation. Its object is the advancement of the science and technology of Electrochemistry, Electronics, Electrothermics, Electrometallurgy, and allied subjects. Electrochemistry includes electrodeposition, corrosion, batteries, electro-organic chemistry, industrial electrolysis, and electrochemical theory and phenomena and techniques in the natural sciences.

Late in 1901, six scientists foresaw a tremendous future for scientific and industrial electrochemistry. They recognized that engineers, scientists, and industrialists, interested in electrochemistry, were then distributed among at least a dozen different societies and had no common medium of communication. Replies to their invitation to form an American Electrochemical Society turned out 351 charter members, comprising persons who believed that such a Society was an imperative necessity, and that through its instrumentality inestimable benefits would accrue to both applied and theoretical electrochemistry. Of the charter members, 52 met in founding the Society on April 3, 1902. Its formation was dictated, and its continuance is assured, by the expanding horizon of the development of electroprocess industries, by research and application in the natural sciences, and by the pressing need for training of persons in electrochemistry.

The vision of the founders has been borne out by the first 50 years of the Society's existence. It has grown even beyond their predictions. There is still the important attainment of assuring adequate training in electrochemistry of chemists, engineers, metallurgists, and natural scientists. Ten thousand tons per day of chlorine, electroplating of many thousands of automobile bumper bars per day, large increases in crop yield per acre, and improved national health, etc., may not be so glamorous as an atom bomb or atomic power, but all of them give us our every day existence and scale of living.

Future Discussions of Electroprocess Industry

Other papers will appear from time to time in this series, to give a more specialized view of such branches of the electroprocess industry as electrothermics, batteries, caustic and chlorine, electrowinning and electrorefining of metals, corrosion, electronics, etc.

Detroit Completes Convention Plans

According to General Chairman Wright Wilson, all Local Committee arrangements for the forthcoming Detroit Meeting are completed. The result is an extensive and diversified program, so arranged that each member will enjoy planning a full schedule to meet his individual interests. As noted in previous issues, the dates for the meeting are October 8th through 12th; headquarters will be the Statler Hotel.

Convention Committees

Listed below are the committees which have been responsible for the Convention arrangements, together with their chairmen and members: *General and Advisory Committee*, Chairman Wright Wilson, Secretary-Treasurer Arthur Linn, Frank Clifton; *Hotel Committee*, Chairman Carl Durbin, Kenneth White; *Registration Committee*, Chairman William P. Innes, Gerald Kingsley; *Entertainment Committee*, Chairman Herberth Head, Co-Chairman Roy Heath, Russell H. Axsom, C. F. Nixon, A. J. Turner; *Ladies' Entertainment Committee*, Chairman Mrs. Alice Pillsbury, Mrs. Russell Axsom, Miss Margaret Baty, Mrs. Herberth Head, Mrs. Carl Heussner, Mrs. C. F. Nixon, Miss Virginia Sink, Mrs. Wright Wilson; *Publicity Committee*, Chairman Robert H. Dudley, S. E. Sangster; *Educational Committee*, Chairman Glenn Coley, Dan Trivich; *Plant Visits Committee*, Chairman Ben Davis, Fred Koerker; *Finance Committee*, Chairman Lee Morse, B. C. Case, Ed. Coe, Guy Cole, Glen Friedt, Jr., Edgar Hahn, George Harding, Jack Hart, J. A. Mullen, Walter Pinner; *Transportation Committee*, Chairman Walter R. Cavanagh.

Technical Program

Wednesday, October 10, 1951

9:00 A.M.—Formal opening of the 100th Convention with Introduction by General Chairman Wright Wilson and Response by President R. M. Hunter.

W. Wilson

Mrs. Pillsbury

H. Head

W. P. Innes

G. Coley

W. R. Cavanagh

R. H. Dudley

L. M. Morse

Batteries

Thursday, October 11, 1951
Primary Cell Round Table
N. C. Cahoon presiding

9:00 A.M.–12:30 P.M.—A round-table discussion of the mechanism of cathode action in alkaline primary cells, including mercuric and copper oxides and porous gas electrodes, the magnesium anode, and anode and cathode behavior in Leclanché cells. It is hoped that an integrated discussion of these various and widely divergent electrodes may result in the formation of general concepts leading to a better understanding of each.

Panel members will be: W. C. Vosburgh, Duke University; E. A. Schumacher, National Carbon Company; and C. K. Morehouse, Olin Industries.

Friday, October 12, 1951
Storage Battery Round Table
E. Willihnganz presiding

9:00 A.M.–12:30 P.M.—A round-table discussion of reactions at the surface of lead immersed in sulfuric acid in terms of double-layer properties and rates of reaction.

Panel members will be: D. C. Grahame, Amherst College; H. Salzberg, Naval Research Laboratories; S. Schuldiner, Naval Research Laboratories; U. B. Thomas, Bell Telephone Laboratories; and C. Wagner, Massachusetts Institute of Technology.

Corrosion

Wednesday, October 10, 1951
Norman Hackerman presiding

9:15 A.M.—"The Nature of Zinc Corrosion Products" by P. T. Gilbert, British Non-Ferrous Metals Research Association, London, England.

9:45 A.M.—"The Dissolution of Magnesium in Hydrochloric Acid" by B. Roald, Norwegian Defense Research Establishment, Lillestrom, Norway, and W. Beck, American Electro Metal Corporation, Yonkers, N. Y.

10:05 A.M.—"The Influence of Oxygen Concentration on the Corrosion of Aluminum in Electrolytic Solutions" by W. Beck, American Electro Metal Corporation, Yonkers, N. Y., and R. G. Gold and F. Keihn, Department of Metallurgical Engineering, Lehigh University, Bethlehem, Pa.

10:25 A.M.—"Corrosion of Aluminum by Carbon Tetrachloride" by Milton Stern and H. H. Uhlig, Corrosion Laboratory, Department of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

10:50 A.M.—"Effect of Oxide Films on the Reaction of Aluminum with Carbon Tetrachloride" by Milton Stern and H. H. Uhlig, Corrosion Laboratory, Department of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

11:15 A.M.—"Resistance of Titanium to Sulfuric and Hydrochloric Acids Inhibited by Ferric and Cupric Ions" by Joseph R. Cobb and Herbert H. Uhlig, Corrosion Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

11:40 A.M.—"Crystal Structure and the Corrodibility of Steels in Inhibited Hydrochloric Acid Solutions" by P. H. Cardwell, Dowell Incorporated, Tulsa, Okla.

2:00 P.M.—"Correlations Between the Parabolic Oxidation Rates of Metals and Properties of Their Oxides" by Andrew Dravnieks, Engineering Research Department, Standard Oil Company (Indiana), Chicago, Ill.

2:30 P.M.—"Structure and Kinetics of Formation of Anodic Coatings on Zirconium" by R. D. Misch and A. H. Roebuck, Argonne National Laboratory, Chicago, Ill.

3:00 P.M.—"A Spectrophotometric Study of the Oxidation of Tantalum" by J. T. Waber and G. E. Sturdy, Los Alamos Scientific Laboratory, Los Alamos, N. Mex., E. M. Wise, International Nickel Company, New York, N. Y., and C. R. Tipton, Battelle Memorial Institute, Columbus, Ohio.

3:30 P.M.—"Role of Crystal Orientation in the Oxidation of Iron" by Earl A. Gulbransen and Roswell Ruka, Chemical Department, Westinghouse Research Laboratories, East Pittsburgh, Pa.

4:00 P.M.—"Electron Diffraction Studies on the Oxidation of Pure Copper and Pure Zinc at Temperatures of 200° to 500°C" by Earl A. Gulbransen and William R. McMillan, Westinghouse Research Laboratories, East Pittsburgh, Pa.

Thursday, October 11, 1951
Corrosion (cont'd.)
Norman Hackerman presiding

9:00 A.M.—"Passivation of Some Metals" by Rudolph Speiser, F. H. Beck, M. G. Fontana, and E. N. Lassettre, Department of Metallurgy, The Ohio State University, Columbus, Ohio.

9:30 A.M.—"Passivity of Iron Films in Nitric Acid" by Harry C. Gatos and Herbert H. Uhlig, Corrosion Laboratory, Department of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

10:00 A.M.—"Surface Reactions of Steel in Dilute Chromate Solutions" by Robert A. Powers and Norman Hackerman, University of Texas, Austin, Tex.

10:30 A.M.—"The Rotogenerative Detection of Corrosion Currents" by J. B. McAndrew, W. H. Colner, and H. T. Francis, Armour Research Foundation of Illinois Institite of Technology, Chicago, Ill.

11:00 A.M.—"Thermogalvanic Potentials, II. Nickel in Neutral Nickel Sulfate Solution" by Dodd S. Carr, The International Nickel Company, Inc., Bayonne, N. J., and Charles F. Bonilla, Columbia University, N. Y.

11:30 A.M. —"Mathematical Studies of Galvanic Corrosion, I. Coplanar Electrodes with Negligible Polarization" by J. T. Waber, Los Alamos Scientific Laboratory, Los Alamos, N. Mex.

12:00 M.—"Effects of Alkaline Detergents on a Magnesium Die Casting Alloy" by J. Fred Hazel, Department of Chemistry and Chemical Engineering, University of Pennsylvania, Philadelphia, Pa., and William Stericker, Philadelphia Quartz Company, Philadelphia, Pa.

2:00 P.M.—"The Mechanism of Dissolution of Titanium in Hydrofluoric Acid" by M. E. Straumanis and P. C. Chen, University of Missouri, School of Mines and Metallurgy, Rolla, Mo.

2:30 P.M.—"Electrochemical Kinetics of the Dissolution of Metals, Especially Titanium in Acids" by M. E. Straumanis and P. C. Chen, University of Missouri, School of Mines and Metallurgy, Rolla, Mo.

3:00 P.M.—"A Polarographic Study of the Influence of Temperature on the Rate of Oxygen Consumption by Iron, Lead, and Zinc" by Paul Delahay, Clarence F. Pillon, Jr., and Douglas Perry, Department of Chemistry, Louisiana State University, Baton Rouge, La.

3:30 P.M.—"The Rate of Corrosion of Silver in Ferric Perchlorate Solutions" by Cecil V. King and Frances S. Lang, New York University, New York, N. Y.

Electrodeposition

Thursday, October 11, 1951
Electroplating Processes
R. A. Woofter presiding

2:00 P.M.—"The Electrodeposition of Silver on Nickel-Steel for a Glass-to-

Metal Seal Arrangement" by R. T. Foley, R. D. Alvord, and J. K. Easley, General Electric Company, Pittsfield, Mass.

2:30 P.M.—"Plating from Alkaline Pyrophosphate Zinc Baths" by J. E. Stareck, Research Laboratories, United Chromium, Inc., Detroit, Mich.

3:00 P.M.—"The Electrodeposition of Aluminum from Nonaqueous Solutions" by Dwight E. Couch and Abner Brenner, National Bureau of Standards, Washington, D. C.

3:30 P.M.—"On Current Distribution Over a Cylinder with Hemispherical Ends" by Sidney Barnartt, Westinghouse Research Laboratories, East Pittsburgh, Pa.

Friday, October 12, 1951
Alloy Plating
R. A. Woofter presiding

9:00 A.M.—"The Mechanism of the Tungsten Alloy Plating Process" by Walter E. Clark, Department of Chemical Engineering, University of Missouri, School of Mines and Metallurgy, Rolla, Mo., and M. H. Lietzke, Oak Ridge National Laboratory, Oak Ridge, Tenn.

9:35 A.M.—"Tin-Zinc Plating in the United States" by Frederick A. Lowenheim, Research Laboratory, Metal & Thermit Corporation, Rahway, N. J.

10:10 A.M.—"Electrodeposition of Rhenium-Cobalt and Rhenium-Iron Alloys" by L. E. Netherton, Victor Chemical Company, Chicago Heights, Ill., and M. L. Holt, Chemistry Department, University of Wisconsin, Madison, Wis.

10:45 A.M.—"The Codeposition of Tin-Nickel from Chloride-Fluoride Electrolytes" by J. W. Cuthbertson and N. Parkinson, Tin Research Institute, Middlesex, England.

11:20 A.M.—"The Electrodeposition of Cobalt-Tungsten-Molybdenum Alloys from Aqueous Citrate Solutions" by R. F. McElwee, U. S. Naval Ordnance Test Station, China Lake, Calif., and M. L. Holt, Chemistry Department, University of Wisconsin, Madison, Wis.

Control of Electrodeposits
M. L. Holt presiding

2:00 P.M.—"The Effect of Temperature on the Cathode Potential during Nickel Plating" by Dennis R. Turner, Electroplating Projects Laboratory, Westinghouse Electric Corporation, East Pittsburgh, Pa.

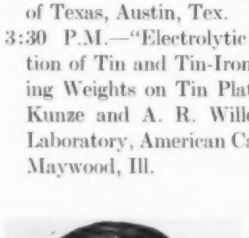
2:30 P.M.—"The Effect of Chloride Ions on Copper Deposition" by W. H. Gauvin, Department of Chemical Engineering, and C. A. Winkler, Department of Chemistry, McGill University, Montreal, Canada.

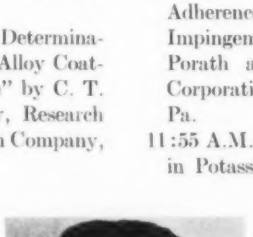
3:00 P.M.—"The Effect of Sulfates of Certain Tripositive Cations in Chromium Plating Baths" by Earl S. Snavely and Norman Hackerman, Department of Chemistry, University of Texas, Austin, Tex.

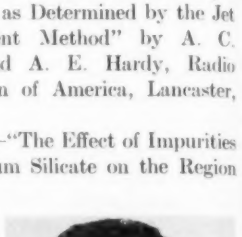
3:30 P.M.—"Electrolytic Determination of Tin and Tin-Iron Alloy Coating Weights on Tin Plate" by C. T. Kunze and A. R. Willey, Research Laboratory, American Can Company, Maywood, Ill.

4:00 P.M.—"A Note on the Structure of Tin-Nickel Electrodeposits" by H. P. Rooksby, Research Laboratories, The General Electric Company, Limited, Wembley, England.

4:30 P.M.—"Stress Reduction of Electrodeposited Nickel" by Vincent J. Marchese, Sperry Gyroscope Company, Division of the Sperry Corporation, Great Neck, N. Y.







Among those who organized the technical sessions, *left to right*—Electrodeposition Division Chairman R. A. Woofter, Corrosion Division Chairman Norman Hackerman, Electro-Organic Division Secretary-Treasurer Harold M. Scholberg

Electronics

Friday, October 12, 1951
Screen Application Methods
Panel Discussion
A. E. Hardy presiding

10:00 A.M.–1:00 P.M.—Papers on the theoretical and practical aspects of screen application and analytical controls:

10:00 A.M.—"Recent Investigations of Streaming Potentials at Phosphor and Glass Surfaces" by J. Fred Hazel, University of Pennsylvania, Philadelphia, Pa.

10:30 A.M.—"Gel Settling" by A. Steadman, Allen B. Dumont Laboratories, Inc., Allwood, N. J.

10:50 A.M.—"Liquid Settled Luminescent Screens" by S. Pakswer and Phyllis Intiso, Rauland Corporation, Chicago, Ill.

11:10 A.M.—"Quantitative Evaluation of the Bonding Properties of Liquid Settling Media for Cathode Ray Tubes" by D. J. Bracco and W. R. Watson, Sylvania Electric Products Inc., Bayside, Long Island, N. Y.

11:30 A.M.—"Screen Wet Strength Adherence as Determined by the Jet Impingement Method" by A. C. Porath and A. E. Hardy, Radio Corporation of America, Lancaster, Pa.

11:55 A.M.—"The Effect of Impurities in Potassium Silicate on the Region of Adherence of Phosphor Screens" by S. A. Hoshowsky and A. E. Hardy, Radio Corporation of America, Lancaster, Pa.

12:05 P.M.—"Particle Size Determination on Phosphors" by R. B. Snyder, Rauland Corporation, Chicago, Ill.

12:20 P.M.—"Water Purification for Use in Electron Tube Manufacturing" by W. J. Hindman, Lansdale Tube Company, Lansdale, Pa.

12:40 P.M.—"Volumetric Determination of Barium" by Thomas J. Manns, Margaret U. Reschovsky, Anthony J. Certa, and M. Sadowsky, Philco Corporation, Lansdale, Pa.

12:50 P.M.—"Strength Specific Gravity Curves for Potassium Silicate Solutions, with Temperature Corrections" by M. Sadowsky, Philco Corporation, Lansdale, Pa.

Screen Application Methods (cont'd.)
Round-Table Discussion
A. E. Hardy presiding

2:00 P.M.–5:00 P.M.—Round-Table Discussion on the morning papers and recent advances in the art of screen application.

Electro-Organic Chemistry

Wednesday, October 10, 1951
Hans Neumark presiding

9:30 A.M.—"Reduction of Aromatic Nitro-Compounds to Aminophenols" by Christopher L. Wilson and Handady V. Udupa, Department of Chemistry, Ohio State University, Columbus, Ohio.

10:00 A.M.—"Electrolytic Reduction of Organic Compounds at Carbon Cathodes" by Sherlock Swann, Jr., C. Y. Chen, and H. D. Kerfman, University of Illinois, Urbana, Ill.

10:30 A.M.—"Electrolytic Oxidation of Chloracetaldehyde to Chloro Acetic Acid" by H. H. Roth, Dow Chemical Company, Midland, Mich.

11:00 A.M.—"The 'Redoxotrol' and Its Application to the Preparation of Pinacols by Controlled Cathode Potential" by Milton J. Allen, National Cancer Institute, National Institute of Health, Bethesda, Md.

11:30 A.M.—"Electrolytic Reduction of Aromatic Carboxylic Acids; Reduction of Benzoic-, Phenylacetic-, and Cinnamic Acid and of Their Esters at a Platinized-Platinum Cathode" by Shinichi Ono, Tadao Hayashi, and Jyunichi Nakaya, Department of Chemistry, Naniwa University, Osaka, Japan.

Electro-Organic Chemistry (cont'd.)
Stanley Wawzonek, Presiding

2:00 P.M.—"The Polarographic Behavior of Streptomycin" by Clark E. Bricker and W. Aubrey Vail, Department of Chemistry, Princeton University, Princeton, N. J.

2:30 P.M.—"The Polarography of Organic Mercury Compounds and Their Mercaptides" by Reinhold Benesch and Ruth E. Benesch, Department of Biochemistry, Northwestern University Medical School, Chicago, Ill.

3:00 P.M.—"A Selective Anodic Oxidation at Controlled Potential" by Alsoph H. Corwin, Hans Brauchli, and Edith C. Davis, The Johns Hopkins University, Baltimore, Md.

3:30 P.M.—"Some Quantum-Mechanical Aspects of Electro-Organic Chemistry" by Allan Maccoll, William Ramsay and Ralph Forster Laboratories, University College, London, W. C. 1, England.

4:00 P.M.—"Conductivity Measurements by Leakage Methods" by G. W. Thiessen, Monmouth College, Monmouth, Ill.

4:30 P.M.—"Polarography of Organic Compounds, XI. The *alpha*-Bromo-*n*-alkanoic Acids" by Isadore Rosen-

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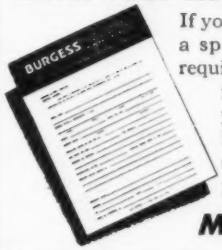

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thal, Charles H. Albright, and Philip J. Elving, Chemistry Department, The Pennsylvania State College, State College, Pa.

Thursday, October 11, 1951
Electro-Organic Chemistry (cont'd.)
Round-Table Discussion
Marshall T. Sanders, Moderator

9:00 A.M.–12:00 M.—Round-Table Discussion with Marshall T. Sanders, Atlas Powder Company, as moderator. Subjects and speakers are as follows:

"Reaction Mechanisms at the Dropping Mercury Electrode," Stanley Wawzonek, State University of Iowa, Iowa City, Iowa.

"Principles Underlying Electro-Organic Reactions," Christopher L. Wilson, The Ohio State University, Columbus, Ohio.

"Principles Involved in the Use of Porous Carbon Electrodes," George W. Heise, National Carbon Research Laboratories, Cleveland, Ohio.

Electrothermics and Industrial Electrolytics

Wednesday, October 10, 1951
Round-Table Discussion
R. C. Hienton, Moderator

2:00 P.M.–5:00 P.M.—Round-Table Discussion of "Power Supply and Requirements for Electrochemical Industries" with R. C. Hienton as moderator. Methods of overcoming shortages of electrical energy and various raw materials and supplies will be discussed informally by representatives of electrochemical industry, public utilities, and government.

Southern Ferro Alloys to Expand

Plans have been made by Tennessee Products and Chemical Corporation for a $1.5 million expansion of its Southern Ferro Alloys Division at Chattanooga, Tennessee. Included in the plan will be the addition of two new furnaces and the construction of a 250-foot natural draft stack for fume disposal.

Davison Plans Large Catalyst Plant for 1953

To meet expanding defense and civilian needs for petroleum raw materials and petroleum products, The Davison Chemical Corporation will erect one of the largest catalyst plants in the United States, on the Calcasieu River, six miles south of Lake Charles, Louisiana. Cost of the plant is estimated at about $7,000,000 and it is scheduled for operation early in 1953. It will have facilities for producing synthetic fluid petroleum-cracking catalyst sufficient to process 600,000 barrels of petroleum stocks per day. The Lake Charles plant will produce the microspheroidal type of synthetic silica-alumina catalyst.

Cotton Labs Enlarge Scope and Facilities

The W. J. Cotton Laboratories, consulting chemists and chemical engineers, recently enlarged both the scope of their work and their facilities at 3530 West Fairmount Avenue, Milwaukee, Wisconsin. These laboratories were established by Dr. Cotton at Butler, Pennsylvania, in 1947 and were moved to their present location in 1950. Recent additions to the staff are Dr. Harold Levine, specialist in food, nutrition, and biochemical work, and John Savignac, physical chemist. In the field of electrochemistry the Cotton Laboratories specialize in corrosion, protective coatings, and particularly in electrical activation of chemical reactions. They also carry on investigations in chemical process development and improvement, cost reduction, and industrial research, particularly on paper products and on biochemical, food, and nutrition problems. Dr. Cotton's special interest in electrical activation of chemical reactions is illustrated by the extensive report he made on this subject in 1946 to The Electrochemical Society [*Trans. Electrochem. Soc.*, **91**, 407–546 (1947)].

O. W. S.

Symposium on Nucleation

The 18th Christmas Chemical Engineering Symposium, arranged by the Division of Industrial and Chemical Engineering Chemistry of the American Chemical Society, will be held at Northwestern University, Chicago (Evanston), Illinois, December 27–28, 1951.

The subject, "Nucleation," deals with phenemona important to such diverse fields as rain-making and steel manufacture or photography and soil mechanics. It is believed that this will be the first broad formal symposium on the subject in this country. Because of the expected wide-spread interest, program arrangements will include review papers so that those unfamiliar with the field may also be readily oriented. The symposium will be grouped under the following headings: Theoretical Aspects, Nucleation from the Gas Phase, Nucleation from the Liquid Phase, and Nucleation from the Solid Phase.

Neither attendance nor participation is limited to American Chemical Society members.

Essay Contest Winners Announced

Winners of the newly established Electrochemical Society Prize Essay Contest for 1951 have been announced as follows:

First prize—Robert Auerbach, 347 East 173rd Street, New York City; second prize—F. L. McGeary, 1120 Leishman Avenue, New Kensington, Pennsylvania.

The winner of the first prize will receive a $100 cash award plus a one-year membership in the Society; the second prize winner will receive $50 and a one-year Society membership. The awards are given for the best undergraduate essay, from 1000 to 2000 words, on the subject of "Cathodic Protection." The Prize Essay Contest was established with financial support from the royalties received from the "Corrosion Handbook," a Society publication.

New Graphite Processing Plant in Niagara Falls

The Graphite Specialties Corporation of Niagara Falls, New York, has announced the completion of a new processing plant to supply impregnated graphite tubes for the chemical industry. Mr. Myron Cory, president of the newly organized corporation, states that production will start in October. All sizes of graphite tubes will be produced.

The Graphite Specialties Corporation is an associate of Falls Industries, Inc., of Solon, Ohio, who which act as sales representative for the Niagara Falls plant.

Storage Battery "Dopes"

The paper by C. C. Rose, "Storage Battery Dopes," which was presented at the Buffalo Meeting of The Electrochemical Society, has recently been published and is available upon request to the Willard Storage Battery Company, 246–286 East 131st Street, Cleveland 1, Ohio.

Mr. Rose, former chairman of the Society's Battery Division, is well qualified to review the situation regarding battery additives or "dopes." In his article he has covered past experience

with these materials, disclosed the mechanical and economic absurdity of the various claims, and given more pertinent technical data about automotive storage battery operation, including data concerning the cause of failure from scrap battery surveys.

The paper, which should be of particular interest to Battery Division members, also includes most significant battery charge voltage characteristics, together with a description of voltage regulators and their effect upon battery service and life.

F. L. LaQue to Address Engineers at L. A.

F. L. LaQue of The International Nickel Company, Inc., New York, will deliver the 1951 Edward Marburg lecture at a Joint Engineering Societies' Symposium on Corrosion, sponsored by Western Region National Association of Corrosion Engineers and Southern California District Council, American Society for Testing Materials. The symposium will be held November 8–9 at Rodger Young Auditorium and Biltmore Hotel, Los Angeles. In addition to the sponsoring organizations, the lecture will be attended by members of other leading engineering societies.

SECTION NEWS

India Section

The first annual meeting of the India Section was held August 2, 1951, under the chairmanship of Dr. B. K. R. Prasad. At the business meeting, Dr. T. L. Rama Char, Secretary-Treasurer, read the first annual report, covering briefly the circumstances leading to the formation of the Section and giving an account of the activities: meetings, Section membership and dues, enrollment of new members in the Society, payment of Society dues through the Section, Patrons of the Section, Committees of the Society and the Section, the reorganization of the editorial staff of the JOURNAL headed by Dr. R. M. Burns, and the appointment of a Regional Editor for India. Activities proposed for the future were then discussed, including issuance of a "Bulletin of the India Section of The Electrochemical Society." Dr. Rama Char concluded by stating that the Section has now started active work and hoped that in the years to come it would play a significant part in the development of electrochemistry. He then expressed his thanks to Dr. R. M. Burns, former Secretary of the Society for his valuable help and encouragement during the formative stage of the Section; the President and Board of Directors of the Society; Dr. H. B. Linford, the present Secretary of the Society, the Chairman and Officers of the Section; the members of the various committees; and the Patrons and the members of the Section for their help and cooperation throughout this period.

The Statement of Accounts for the period ending December 31, 1950, was presented by the Secretary-Treasurer and passed. The following members were elected as officers of the Section for 1951–52: *Chairman*, B. K. R. Prasad; *Vice-Chairmen*, J. Balachandra and K. Rajagopal; *Secretary-Treasurer*, T. L. Rama Char. The business meeting was concluded with a vote of thanks to the Chair.

At the technical session, Dr. B. K. R. Prasad delivered a lecture on "Power Development and Electrochemical Industries in India." He stated that the power resources in India should be fully tapped and electrochemical industries started or developed to the best advantage of the country. The speaker then indicated the possible location of the industries at various centers close to the power supply and laid special emphasis on high purity caustic soda, electric furnace processes, electrolytic hydrogen, aluminum, and electrolytic recovery of metals from scrap. He concluded by giving the rates at which power should be made available to the industries for economic success.

Mr. K. Rajagopal then gave an account of the growth of the alkali-chlorine industry at Mettur. This was followed by a lively discussion. The session ended with a vote of thanks to the Chair.

* * *

P.S.N.S. Ambalavana Chettiar and Company, Madras, have become Patrons of the India Sections.

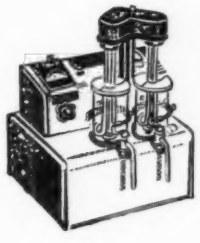
T. L. RAMA CHAR, *Secretary-Treasurer*

PERSONALS

RODNEY E. BLACK has left Morningside College, Sioux City, Iowa, to accept a position in the Department of Chemistry, University of Kentucky, Lexington, Ky.

T. R. ANANTHARAMAN, who has been at the Indian Institute of Science,

fabulously fast
metal separations by
DNYA-CATH mercury cathode



For determination of aluminum in steel, aluminum in zinc base alloys, and other separations—DYNA-CATH is a completely new high speed mercury cathode apparatus which accelerates and does a more complete job in the analytical separation of metals. For example, DYNA-CATH quantitatively removes 5 grams of iron from 100 ml. of electrolyte in 60 minutes. It overcomes the difficulties which have prevented utilization of the mercury cathode as an analytical tool.

Write for Bulletin 220.

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Bangalore, has been awarded the Rhodes Scholarship for India for 1951. He will leave for England in October to begin his doctorate research under W. Hume-Rothery at the University of Oxford.

T. L. Rama Char, Secretary-Treasurer of the India Section of the Society, has been elected a Fellow of the Indian Chemical Society.

A Joga Rao has been awarded the degree of Doctor of Science by the Benares Hindu University at Benares, India.

Charles B. Sanborn, formerly of the American Steel and Wire Company Research Laboratories, Cleveland, Ohio, has recently joined the staff of Graham, Crowley & Associates, Inc., Consulting and Research Chemists. He will be located in the Chicago laboratories of the company. Mr. Sanborn is a Past Chairman of the Cleveland Section of The Electrochemical Society and has long been active in Society affairs.

Parker S. Dunn of Carlsbad, New Mexico, is now at the American Potash & Chemical Corporation, Trona, Calif.

BOOK REVIEWS

Refractories Bibliography, 1928–1947 inclusive. Published by American Iron & Steel Institute, New York City, and The American Ceramic Society Inc., Columbus, Ohio, 1950. 2109 pages, $15.00.

This imposing volume constitutes a notable addition to the literature on refractories. There is no question that it is the outstanding work of its kind in this important field. It supplements three bibliographies, published by The American Ceramic Society, which covered magnesite and silica refractories in 1924 and the general subject of refractories in 1927.

Not only have more than 1150 periodicals been reviewed in preparation of the abstracts but both the U. S. and foreign patent literature have been examined to make the information contained as complete as possible.

Over 13,300 carefully prepared abstracts are listed. The references are arranged by authors, whose names are listed alphabetically. A carefully prepared subject index totaling 66 pages permits ready reference to the individual items. E. F. Lowry

A Romance in Research, The Life of Charles F. Burgess, by Alexander McQueen with foreword by George W. Heise and technical appendix by O. W. Storey. Published by The Instruments Publishing Company, Pittsburgh, Pa., 1951. 429 pages, $6.00.

"A Romance in Research" is a notable book because it tells the inspiring story of Charles F. Burgess. It will carry his influence to those who did not have the privilege of knowing him, and at the same time will broaden and deepen the understanding of his achievements and character for those who did know him. Alexander McQueen has patiently and skilfully collected, arranged, and reported both pertinent details and outstanding events in a career which was the outward manifestation of a keen and active mind, and a noble spirit.

The book is narrative in form, and starts in 1869 with an account of the trip of Anna Heckman from Nova Scotia to Lynn, Massachusetts, so that she might be nearer to Fred Burgess, her betrothed. He had preceded her to the United States and had settled in Wisconsin. By working in a shoe factory in Lynn, she helped to accumulate the "nest egg" that would start them in a home of their own. They were married in February, 1872, at Lynn; and their honeymoon was a trip to Oshkosh, Wisconsin, which was to be their home.

Their first born was Charles Frederick, who arrived in January, 1873. His boyhood included some memorable trips to visit his grandparents in Nova Scotia, attendance at an occasional county fair, and the earning of money of his own through a paper route. This helping to earn his way continued through his years at the University of Wisconsin where he chose the relatively new course in electrical engineering.

The story of his postgraduate years as an instructor, assistant professor, and finally professor at the University of Wisconsin is well told. It includes the beginnings of the course in electrochemistry at Wisconsin, and also the setting up of the course in chemical engineering as a definite division of the School of Engineering.

The year 1903 brought his marriage to Ida May Jackson, who had been a Milwaukee newspaper reporter, and later had been appointed Factory Inspector by the newly elected governor, Robert M. LaFollette. It also brought increasing numbers of consulting projects to the young professor. These gave him firsthand contact with industrial operations and sharpened his already well-developed sense of the importance of applying scientific principles and discoveries to everyday work.

As the years went on, his own research and consulting projects absorbed more and more of his time. In 1910, The Northern Chemical Engineering Laboratories were established in Madison, and operated by Burgess as an independent enterprise along with his teaching at Wisconsin. By 1913, the attention required by his own business had reached the point where he felt that resignation from the university faculty was necessary, and he took this step. The laboratory was known then as the C. F. Burgess Laboratories, and under that name it served its clients well for over thirty years.

This earlier period demonstrated Burgess' outstanding qualities as a scientist, an inventor, a teacher, and a research worker. The years following his resignation from the university showed his capacity as an industrialist and businessman. The account of the starting of the Burgess Battery Company and its eventual outstanding success is just another example of the results from a combination of ingenuity, resourcefulness, persistence, and hard work. No less than ten operating and producing companies stemmed from the work done in the Burgess Laboratories. Most, if not all, of them are still in business.

As an industrialist, Burgess showed his characteristic broadmindedness and tolerance in his relations with the employees who staffed his various enterprises. He was among the first to adopt progressive labor relations policies, which are commonplace today but which were considered almost revolutionary then.

With his scientific and technical background, his setting up of handicraft shops, first in Chicago and Jacksonville, Florida, and later in Milwaukee and other cities may seem a strange course to follow in the closing years of his career. It tied in, however, with his underlying philosophy of independence and self-reliance. He felt that young people in particular, and adults when they have leisure time, should learn to do things with their hands, and thus find the joy of creating.

Two groups of readers will find special pleasure and satisfaction in this book. Members of The Electrochemical Society will remember C. F. Burgess as a charter member and Past President of that society. His charter membership

implied no casual interest, but rather very direct and active concern for the development of the young association and the science to which it dedicated itself. Burgess contributed freely and generously of his time and talent in furthering electrochemical progress, and those members of the Society who worked with him will long cherish the memories of that relationship.

The second group includes all who love Wisconsin, and particularly the University of Wisconsin. Charles F. Burgess truly loved the state in which he was born, and the university that helped him to achieve maturity of mind and spirit. His whole career may be regarded as a shining tribute to fine parents and to the progressive and enlightened community and educational atmosphere in which he grew up.

"A Romance in Research" is enriched by a brief but effective foreword by G. W. Heise, and a technical appendix of 62 pages by Oliver W. Storey, who was particularly well qualified for this assignment, having been continuously associated with Dr. Burgess during the aast thirty-five years of his scientific and lbusiness career. Each of ten chapters in the appendix tells of Burgess' activities in, and contributions to, some special phase of applied electrochemistry. In addition, a complete listing of Burgess' publications and of patents granted to him is shown, as well as a supplementary list of patents in which he had some part. The appendix is done with Dr. Storey's usual thoroughness; and is obviously a work of affection and respect for the man who is its subject.

Alexander McQueen has given us a three-dimensional account of an outstanding man, whom some of us have had the privilege of knowing. Through this book, those who have not known him can still be inspired by his genius for applied research, and by the shining example of an unusually productive and useful life.

PAUL S. BRALLIER

BASIC ORGANIC CHEMISTRY by J. Rae Schweack and Raymond M. Martin. Published by the Blakiston Company, New York, Toronto, Philadelphia, 1951. ix plus 323 pages, $4.50.

"Basic Organic Chemistry" is a textbook prepared primarily for those who require a knowledge of the basic principles of organic chemistry especially as it applies to their various fields of specialization. With this purpose in mind the authors have gone to considerable length to simplify the complex subject matter and to facilitate the transition from general to organic chemistry. Although the field, from aliphatics to heterocyclics, is dealt with, the amount of material has been reduced to such an extent that only seventeen chapters are devoted to this part of the text. Though at first glance this might appear to be very condensed, the authors have done an excellent job of covering the important principles. Where examples have been used to elucidate a type compound, or a reaction, those examples which would be of popular interest in related fields have been selected. This is but one way in which the text has feen prepared to popularize organic chemistry. The short prologues are provocative and should tempt a student to read on with interest into the more academic text of the chapter.

Nomenclature has always been a stumbling block in the teaching of organic chemistry since so many nonrelated systems of nomenclature are in common use. The nomenclature of the International Union of Pure and Ap-

New ELSEVIER Books

For the Electrochemist in Industry and in Education

TEXTBOOK OF ELECTROCHEMISTRY

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A dual-purpose work that provides a clear understanding of the fundamentals of the subject while presenting a comprehensive summary of modern electrochemistry to facilitate its use as a research tool. An important feature of the work is a chapter on experimental technique.

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plied Chemistry has been used throughout this text. Common names for compounds have been used in only a few instances and though common names are introduced along with a new compound, the discussion is continued using the conventional terminology of the International Union. There is a chapter devoted to the various systems of nomenclature which is designed to orient the reader with respect to other systems in common use.

The final three chapters and the appendix present a unique summary of the field of organic chemistry. Each section is concerned with a closely related field such as industrial or physiological chemistry. Here the practical applications of organic chemistry are stressed and the modern advances in these fields are presented. Thus the student is shown how his own field is enriched through organic chemistry and the importance of the new science is clearly demonstrated. Though the authors state in their prefix that this is in no way a reference text, it might afford a good review for those working in related fields who could become lost in the maze of detail usually found in the more advanced texts on organic chemistry.

W. L. Hawkins

LETTER TO THE EDITOR

Dear Sir:

Just a brief note to express my appreciation of "Der International, Scientist" in the July issue. Surely "die schoenste Lengwitsch" is one of the most amusing media of communication the American has dreamed up. I cast my vote for it as an international language, to replace Esperanto, Ido, Volapük, and other abortive schemes.

The obvious deduction, that there are still enough scientists who have a thorough enough knowledge of German to appreciate such an article, is gratifying to reflect on.

Ralph Hagedorn
Burbank, California

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RECENT PATENTS

Selected for electrochemists by Fred W. Dodson, Chairman of the Patent Committee, from the Official Gazette.

May 29, 1951

Brown, F. M., and Dawkins, K., 2,554,557, Vent Plug and Liquid Level Indicator for Batteries

Godley, P. 2nd, 2,554,902, Thermionic Discharge Device Control

Farmer, Q. B., 2,554,943, Electroplating Apparatus

Doucot, R., 2,554,979, Element of Asymmetric Conductivity of Selenium

Merrill, J. B., and Davis, A. B., 2,554,999, Zinc Silicate Phosphor

Doughty, L. A., 2,555,225, Separator for Storage Batteries

Saslaw, O., 2,555,247, Semiconductive Cell

June 5, 1951

Chubb, M. F., 2,555,301, Process for Pasting Battery Plates

Dalton, H. R., and Cooley, A. G., 2,555,321, Facsimile Recording Paper

Ramage, J. H., 2,555,372, Method of Coating Refractory Readily Oxidizable Metals

Ruemmler, W. P., 2,555,375, Process of Plating Bright Silver Alloy

Haugaard, G., and Krone, T. D., 2,555,487, Chromatographic Process and Apparatus

Pratt, E. B., 2,555,507, Method of Reducing Metallic Oxide Ores

Thompson, R. B., 2,555,518, Photochemical Preparation of Polyphenylalkanes

Krefft, H. E., 2,555,749, Fluorescent Lamp

Kolka, A. J., and Orloff, H. D., 2,555,889, Manufacture of Benzene Hexachloride

Rosenthal, R. L., and Tobias, C. W., 2,555,937, Method and Apparatus for Measuring Resistance of Blood During Clotting

Vonada, E. E., 2,556,017, Electrolytic Method and Apparatus for Cleaning Strip

James, E. L., Duim, A. R., and Wallace, J., 2,556,089, Cathodic Protection Device

June 12, 1951

Tingle, L., 2,556,238, Thermocouple Construction

Silverman, D., 2,556,558, Tourmaline Crystal Elements for Pressure Gauges

Skowronski, S., and Mosher, M. A., 2,556,635, Electrolytic Refining of Copper

Pike, V. B., 2,556,705, Electrolysis Switch

Teal, G. K., 2,556,711, Method of Producing Rectifiers and Rectifier Material

Thrune, R. I., 2,556,830, Graphite Anode

June 19, 1951

Cerulli, N. F., and McNall, J. W., 2,557,372, Manufacture of Thoria Cathodes

Ogan, A. C., 2,557,458, Method of Fusing Alloy Additions to a Steel Bath

Hogaboom, G. B. Jr., 2,557,503, Anode for Electroplating Phonograph Recordings and Shells Produced Therefrom

Miller, D. E., 2,557,509, Composition and Process for Protecting Ferrous Metals from Rusting in Moist Air

Bancroft, G. H., 2,557,530, Electric Heating Element

Schneider, F. A., 2,557,615, Alkaline Battery

Holbrook, T. R., 2,557,823, Method of Forming a Composite Article Comprising Steel and Silver

Clarke, W. C. Jr., 2,557,862, Internal-Combustion Engine Valve

June 26, 1951

McIntosh, K. L., 2,557,989, Electrolytic Water Correction Device

Jernstedt, G. W., 2,558,090, Periodic Reverse Current Electroplating Apparatus

Gray, R., 2,558,246, Jointing of Metal Inserts to Thermoplastic Articles

Triplett, R. L., 2,558,282, Electrical Instrument Construction

Kolka, A. J., and Orloff, H. D., 2,558,363, Photocatalytic Manufacture of Benzene Hexachloride

Aller, C. B., 2,558,504, Method of Producing a Printing Form Having a Bimetallic Surface

Banca, M. C., 2,558,532, Cathode-Ray Screen Coated with Zinc or Magnesium Fluoride Phosphors

Pyk, S. C., 2,558,627, Method for the Production of Zirconium Alloys

Kendall, T. L., Mahoney, D. G., and Crooks, L. G., 2,558,654, Storage Battery Vent Plug

July 3, 1951

Gray, V. R., and Steiner, H., 2,558,844, Photooxidation of Aliphatic Olefinic Hydrocarbons

Zinn, W. H., 2,558,919, Method for

Measuring Radiation of Neutrons
Sykes, J., 2,559,031, Copper Base Alloys
Verheyden, A., 2,559,033, Electrolytic Process of Producing Diacetone-Keto-Gulonic Acid
Verheyden, A., 2,559,034, Electrolytic Process of Producing Diacetone-Keto-Gulonic Acid
Ludeman, C. G., 2,559,219, Detection and Measurement of Penetrative Radiation
Raper, J. R., 2,559,259, Method of Making a Source of Beta Rays
Smith, H. B., 2,559,263, Electropolishing of Metals
Reidel, M., 2,559,370, Process for the Manufacture of Oxide of Copper Rectifiers
Becker, C. W., 2,559,530, Cathode Coatings

July 10, 1951

Skinner, R. E., and McIntyre, G. H., 2,559,683, Electric Enamel Furnace
Hammerquist, W. L., 2,559,874, Manganese Electrowinning Process
Beebe, J. D., 2,559,926, Anode Basket
Borell, G. L., and Nystuen, M. I., 2,560,209, Conductivity Cell

July 17, 1951

Adler, O. E., 2,560,534, Method of Operating a Continuous Electroplating System
Gibney, R. B., 2,560,792, Electrolytic Surface Treatment of Germanium
Zachlin, A. C., 2,560,836, Battery Plate Forming Tank
Ferrand, L., 2,560,854, Apparatus for the Continuous Operation of Cells for the Electrolysis of Molten Salts
Gambetta, E. L., 2,560,857, Apparatus for Measuring Electrochemical Potentials
Klumb, G. H., 2,560,960, Cathodic Protection for Water Softeners and Filters
Kopper, E., and Radeke, W. H., 2,560,962, Battery Cell Indicating Device
Lee, H. J., 2,560,966, Method of Electroplating Copper Clad Stainless Steel Cooking Vessels
Daily, J. M., 2,561,014, Ozone Generator
Tilton, D. G., 2,561,077, Radiation Pyrometer
Passal, F., 2,561,222, Electrolytic Method of Stripping Nickel, Chromium, Copper, Zinc, Cadmium, Silver, Tin, and Lead Electrodeposits from Ferrous Basis Metals, and Compositions for Use Therein

July 24, 1951

Emerson, C. L. Jr., 2,561,656, Electrolytic Production of Polyhydric Alcohols
Peyches, I., 2,561,818, Electrolytic Method of Protecting the Wall of a Glass Furnace
Moulton, J. D., Enters, R. F., and Moufang, H. F., 2,561,943, Electric Battery

NOTES FROM INDUSTRY

Products

MONO-BED DEMINERALIZER. The Penfield Manufacturing Company of Meriden, Conn., has announced a new Mono-Bed Demineralizing Unit which, it states, operates upon the most efficient and effective deionizing technique available to industry. Cation and exceptionally strong base anion exchangers are intimately mixed in a single unit tank, thus providing in one container the equivalent of a large number of "multiple bed systems." The raw water passes through this Mono-Bed column only once, yet comes out with a mineral content of virtually zero.

The Penfield Demineralizers are ideal for a large variety of industrial operations, including power plants, mirror plating, electronic and anode tubes, photographic finishing, and wherever exceptionally high purity, completely mineral-free water is required. Complete catalog information will be sent on request.

NEW CHROMATE COATING PROCESS. "Enthox" is the name of a new, simplified process for producing chromate coatings on zinc and cadmium, just announced by Enthone, Inc., Dept. JES, 442 Elm St., New Haven, Conn. The manufacturer states that outstanding features are low cost and ease of operation. From 1 to 2 ounces of salts are used per gallon of water. The mixture is operated at room temperature, and after immersion for a few seconds, an adherent, chromate coating is produced. Various colors can be applied to the "Enthox" coatings by means of suitable dyes. It is sold as a powder mixture.

ENAMELSTRIP, the trade name for metal coils, pre-coated in color and precision slit to exact width, is offered for sale by The Coated Coil Corporation, 501 West 30th St., New York, N. Y. Enamelstrip is produced by the Enamelstrip Corporation, Allentown, Pa., and is notable for its versatility and adaptability to many industrial uses. The coil is available in cold-rolled steel, electro-galvanized steel and electrolytic tin plate, brass, zinc, and aluminum, in any desired color or shade, coating on one or two sides. The coating process enables the coil to withstand the stresses of drawing, bending, forming, and fabricating without cracking or peeling. It eliminates the need for many costly steps normally required for enameling or painting after the metal is formed.

ADJUSTABLE PRECISION VOLTAGE REFERENCE. A new, adjustable, all-electronic "secondary standard cell," operating from a-c mains to provide a continuously variable d-c supply over the wide range of 0.0001 to 10 volts, has been developed by General Precision Laboratory, Inc., of Pleasantville, N. Y. It is a precision unit designed primarily to work with high impedance devices—for d-c amplifier testing, calibration of d-c oscilloscopes and V-T voltmeters, determination of vacuum tube characteristics, and other laboratory and industrial uses. Maximum output impedance is 1,000 ohms, with accuracy maintained at 0.1% of full scale and is operable with input voltages of 105–130 volts, 50–60 cycles, with full accuracy.

Publications

36-PAGE SOLDER CATALOG. Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York City, has published an educational brochure on the nature, properties, and uses of solder. The 36-page book, the first of its kind on the subject, is profusely illustrated.

A wealth of subject matter is contained in the catalog including sections on thermal effects, mechanical properties, principles of soldering, etc. Selection of the proper solder for a job is explained, a remarkable group of alloys with low melting points described, and a list of practical applications and a resume of technical data given. This catalog is basically an editorial treatise that is a valuable addition to any library. It is available on request.

CARBON BRUSHES FOR ELECTRIC EQUIPMENT, a new two-color, 28-page booklet is available from the General Electric Company, Schenectady, N. Y.

The bulletin (GEA-5597) describes and illustrates the fundamentals in the design, application, and manufacture of carbon brushes and includes sections on brush terminology, types of brushes characteristics of brush grades, etc. Sent on request.

BULLETIN ON IMPROVED METALLOGRAPH. A very simple but compact (12 in. x 12 in. x 18 in.) instrument that is complete with every facility for examining, studying, and photographing metal samples and other materials, even large heavy samples, is illustrated and described. Microphotographs made by the instrument of hypereutectoid steel samples are shown at magnifications of 400×, 1200×, and 3400×. Free on request from F. T. Griswold Manufacturing Co., 305 W. Lancaster Ave Wayne, Pa.

WHAT'S NEW FOR THE LABORATORY, is a 16-page booklet just issued by Scientific Glass Apparatus Company Inc., Bloomfield, N. J. Illustrated and described are a number of new, interesting items, including a Constant Temperature Water Bath, Vertical Autoclaves, a One-Pan Balance which does not require the attachment of weights, Flexible Heating Tape, a new type spray which reduces air-borne bacteria while simultaneously eradicating odors, and an electronic temperature controller. Copy free on request.

PACKAGED POWER, a new 24-page bulletin on packaged electric power for industrial expansion, is now available from the General Electric Company, Schenectady, N. Y. The publication (GEA-5600) outlines methods of obtaining electric power equipment for quick expansion at low cost and with a minimum of critical materials. Use of "packaged" electrical systems, it explains, simplifies plant engineering problems, cuts equipment and installation costs, conserves vital materials and manpower, and insures quicker delivery of electrical equipment.

Included also is a list of 31 other G-E bulletins on available equipment for industrial power expansion.

NEW CAUSTIC SODA BULLETIN. Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., has just issued a new Caustic Soda bulletin prepared for all users of this important basic chemical. Divided into four sections under tabbed headings, the 24-page booklet provides an excellent reference for particular problems on purchasing, handling and storage, equipment design, and technical data.

Purchasing departments will find the comparison of various forms of caustic soda and the evaluation of shipping helpful. The section on equipment design, including charts and tables, deals with the problems of engineering, construction, and maintenance personnel. A separate leaflet covering instructions for safe handling of caustic soda tank cars is enclosed. Requests for copies should be on company letterhead.

BIBLIOGRAPHY. Alrose Chemical Company, Manufacturing Chemists, Providence, R. I., has released a bibliography on analytical applications for ethylenediamine tetraacetic acid. More than 40 references, none of which is more than three years old, indicate the growing importance of this product in chemical analysis. Free copy on request.

Personalities

RAYMOND C. MACHLER has been appointed Director of Research and a member of the Executive Committee of Leeds & Northrup Company, Philadelphia, Pa. Dr. Machler succeeds I. MELVILLE STEIN, who recently was elected to the newly created post of Executive Vice-President.

R. A. LEES has joined the Automotive Rubber Company, Inc. of Detroit as General Plant Manager, with complete responsibility for operation of the company's new rubber mill and all processing departments.

EDWARD M. TUFT has been named to the newly created post of Vice-President in charge of Organization Development of the RCA Victor Division, Radio Corporation of America. Concurrently, ALBERT F. WATTERS, former Assistant Director of Personnel, has been promoted to Director of Personnel for the RCA Victor Division.

J. L. CHRISTIAN has been elected a Vice-President of the Monsanto Chemical Company, St. Louis, Mo. The company also announced the appointment of HOWARD K. NASON as Director of Research of the Organic Chemicals Division of the company, succeeding Dr. Richard M. Hitchens.

ARTHUR E. MIDDLETON has been placed in charge of research on dielectrics and semiconductors at Battelle memorial Institute, Columbus, Ohio.

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METALLURGIST, B.S. (Chem.), postgraduate work in metallurgy. Research and process development experience in the application of leaching, furnace, and electrolytic methods to the recovery of and refining of copper, lead, tin, silver, cadmium, and other nonferrous metals, Experience, metals powders. *Reply to Box 345.*

Position Available

B. S. OR M. S. CHEMIST, CHEMICAL ENGINEER OR METALLURGIST, with several years of practical experience in metal finishing, for process development and technical service work in modern light metals research laboratory located in Pacific Northwest. Please give specific details of education, experience, salary requirements, and availability date. All inquiries treated in confidence. *Reply to Box A-233.*

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